Scientific Journal of Impact Factor (SJIF): 4.72

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 4, Issue 4, April -2017

PERFORMANCE ANALYSIS OF VERMICOMPOST SPREADER WITH A CULTIVATOR

P.Jegan[#1], P.Jerry Vasanth[*2]

[1, 2] *Assistant Professor*

Department of Mechanical Engineering, Roever Engineering College, Elambalur, Perambalur – 621 212

ABSTRACT:

The main objective of this project is to analysis the performance of mechanical type fertilizer spreader with a cultivator for the agricultural purpose. A method was generated to spread the Vermicompost fertilizer over a fallow land uniformly by dropping the vermicompost fertilizer over the impeller disc. The system consists of three wheels and two hoppers. The wheels are used to impel the fertilizer and two hoppers are used to store the fertilizer. These hoppers are placed at some height from the wheel axle so that the fertilizer falls on to the impeller. The hopper is provided with a flow control mechanism. Below this system there is an impeller mounted on the output shaft. Due to centrifugal action, the fertilizer spreads in the farm land. This high value of centrifugal force is generated by the help of proper gear reduction ratio. The gears are coupled to the shaft of wheel.

Keywords: *Vermicompost fertilizer, Impeller disc, centrifugal force.*

I. INTRODUCTION

India is an agricultural country where around 73% of population is directly or indirectly depends upon the farming. But till now our farmers are doing farming in same traditional ways. They are doing seed sowing, fertilizers and pesticides spraying, cultivating by conventional methods. There is a need of development in this sector and most commonly on fertilizers, pesticides spraying technique, since it requires more effort and time to spray by traditional way. Most of the Asian nations are at developing stage and they are facing the problem of high population and as compared to that agricultural productivity is much lower as compared to developed nations. India is one of the nations who are facing the same problem. This is caused due to low level farms, insufficient power availability to farms and poor level of farm mechanization. In order to meet the requirement of food of growing population and rapid industrialization, there is a need of the modernization of the agricultural sector. On many farms production suffers because, delay in sowing, improper distribution of pesticides and fertilizers, harvesting. Mechanization solves all the problems which are responsible for low production. It conserves the input and precision in work and get better and equal distribution. It reduces quantity needed for better response, prevent the losses and wastage of input applied. It gets high productivity so that cost of production will reduce to obtain the requirement of production Agriculture implement and machinery program of the government take steps to increase availability of implement, pumps, tractors, power tillers, harvester and other power operated machines. Special emphasis was laid on the later as more than 65% of the farmers fall in small and marginal category. Generally mechanization of small forms are very difficult and on-affordable but Japanese are doing it by proper mechanization and they did farming to get more production. They use the modern time saving machine of required sizes to yield high production. Japanese led agriculture to new heights. The application of dry granular materials such as fertilizers, herbicides, and pesticides has been traditionally performed with equipment that was intended for constant application rates

1.1 Mechanical Type Spreader

Some plantation groups have devised various attachments to enhance their mechanical spreading costs; one of such is the crane attachment. The crane is specially designed to mount onto the back of the tractor 3-point linkage, and then the spreader is attached to the rear of the crane. This combination will necessitate the fitting of an auxiliary hydraulic services control valve to

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the tractor hydraulics to enable both the crane and the 3-point linkage to function properly. Rear discharge for single terraces using a crane with a spreader these cranes will lift a specially supplied 500 kg bag and fill the spreader hopper in one go. By doing this, the complete operation will require only one person i.e. the tractor operator. Considerable costs savings are achieved. The bunch ash spreader was developed to handle bunch ash that will be difficult to be used with a normal fertilizer spreader due to its poor-flowing characteristics and bulk. Normal inorganic fertilizers are about double the weight of bunch ash, as such a much larger container is required to contain the ash to save turn-round time. Although bunch ash is a very cheap source for K and has high pH neutralizing properties for acidic coastal soils, its use may be limited due to the difficulty in sourcing bunch ash.

Mechanical spreaders have been used to apply fertilizers under oil palm conditions in Malaysia since the 70s. Through the years, various methods and types of machine designs have been used. These various designs were discussed with particular emphasis on the Turbo-spin air assisted spreader together with different application methods in different conditions. Some costing analysis was indicated. There have been many “semi-mechanical” systems developed by planters themselves to cope with various ‘unique’ conditions. A popular one is to have a trailer drawn by a tractor loaded with fertilizers and carrying a number of workers manually throwing fertilizers onto the sides. Tractor mounted fertilizer spreaders have proven to be the best alternative due to the following advantages, Spreading time flexibility, although dependent on weather, but much more flexible than aerial. Uniformity in spread So far, the lowest cost method, Minimized labor requirement, Minimal fertilizer wastage, But in order to get the above benefits, the following are necessary such as trained operators, proper machine maintenance schedules, field conditions conducive to allow tractors enter the field such as clean tractor paths, good headland for turning, etc., Have other requirements to complement this system e.g. transport systems, suitable, tractors, cranes etc…

1.2 Spraying Methods

- Backpack method,
- Lite-Trac method,
- Bullet Santi method
- Aerial Sprayer method

1.3 Vermicompost Spreader

Here we are modifying the conventional sowing method into mechanical type fertilizer spreader with a cultivator. A method was generated to spread the uniformly over a fallow land by dropping the fertilizer over the impeller disc. The system consists of three wheels and two hoppers. The wheels are used to impel the Vermicompost fertilizer and two hoppers are used to store the fertilizer. These hoppers are placed at some height from the wheel axle so that the Vermicompost fertilizer falls on to impeller. The hopper is provided with flow control mechanism. Below this system there is an impeller mounted on output shaft. Due to centrifugal action, the Vermicompost fertilizer spreads in the farm. This high value of centrifugal force is generated by the help of proper gear reduction ratio. The gears are coupled to the shaft of wheel.

It is the common requirement of most estates that no fertilizer are to be dropped onto the tractor path, this is because the tractor paths are compacted and takes a lot longer for fertilizers to become available to the palm roots. Furthermore, fertilizers are also picked up by tractor wheels, human and animal feet, etc. and taken to areas where they are not needed e.g. to the mill or tractor yard. Washout also occurs during rain on compacted ground. Reports have come from estates that as much as 30% of fertilizers still drop onto tractor path using the pendulum system.

II. PROPOSED WORK PROCESS

2.1. Problem Identification

The main problem in the conventional sowing methods is the requirement of high labors, wastage of the fertilizers, Non-uniformity in sowing. These problems will lead into decrease in the yield of production. The above said problems can be reduced by the mechanization of fertilizer spreader with the trained operators, proper machine maintenance schedules, field conditions conducive to allow tractors enter the field such as clean tractor paths, good headland for turning, etc., and other requirements to complement this system e.g. transport systems, suitable, tractors, cranes etc…which will allow to increase the yield.

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III. EXPERIMENTAL SETUP

The mechanized Vermicompost spreader with a cultivator setup has five major components. They are,

- Hopper,
- Spreaders
- Chain,
- Rotating shaft,
- Spreader with a cultivator.

3.1 Hopper

Hopper is a device that can be used in the cultivator; it is used to store the Vermicompost fertilizer and passed to the cutter.

3.2 Spreader

Spreaders are attached on the tow-ball on your ATV 4-wheel or 3-wheel motorcycle. There is provision to "level up" the spreader drawbar so that the hopper is perpendicular. It should be slightly tilted forward so that the weight is loading the drawbar, but not so far forward as to cause the Vermicompost fertilizer to spill out. Changes in temperature and relative humidity in the atmosphere may cause variation in the flow characteristics of fertilizers. This means that the sowing densities of seeds, even of the same varieties, will slightly differ. The recommended speed on the Calibration chart is for the Spreader to be towed at 15 kph. In practice this isn't always possible, so the operator must take a lower speed into account when the conditions justify this.

3.3 Chain

Chains are used to transmit the power from the driving shaft to the driven shaft. The powerful motors combined with hub gears and derailleur's can transmit extremely high torques of 250 to 300 watts to the chain. They generate high-load peaks which only a few components can tolerate permanently. Connex is responding to this challenge with e-bike specific chains which draw on our wide-ranging expertise in the industrial sector. The special geometry of the teeth, combined with the tested and proven hardening processes, provide our e-bike sprockets with the strength to better withstand the stresses generated by e-bike motors

3.4 Rotating Shaft

A power take-off or power takeoff (PTO) is any of several methods for taking power from a power source, such as a running engine, and transmitting it to an application such as an attached implement or separate machines.The manure spreader can be coupled with the tractor only with help of properly matched PTO shaft..Prior each start-up of the spreader make sure that all guards are efficient and at their places. Damaged or incomplete guards should be replaced with new ones (original).After installation of the PTO shaft make sure that it is properly and safely connected to the tractor and to the spreader.

3.5 Cultivator

cultivator is any of several types of farm implement used for secondary tillage. One sense of the name refers to frames with the teeth (also called shanks) that pierce the soil as they are dragged through it linearly. Another sense refers to machines that use rotary motion of disks or teeth to accomplish a similar result. The rotary tiller is a principle example. Cultivators stir and pulverize the soil, either before planting (to aerate the soil and prepare a smooth, loose seedbed) or after the crop has begun growing (to kill weeds controlled disturbance of the topsoil close to the crop plants kills the surrounding weeds by uprooting them, burying their leaves to disrupt their photosynthesis, or a combination of both).

IV WORKING PRINCIPLE

4.1 Vermicompost Spreader

A method was generated to spread the uniformly over a fallow land by dropping the fertilizer over the impeller disc. The system consists of three wheels and two hoppers. The wheels are used to impel the fertilizer and two hoppers are used to store the fertilizer. These hoppers are placed at some height from the wheel axle so that the fertilizer falls on to impeller.

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Below this system there is an impeller mounted on the output shaft. When the power is given to the system the impeller disc starts rotates and produces the centrifugal force. Due to centrifugal action, the Vermicompost fertilizer spreads in the farm. This high value of centrifugal force is generated by the help of proper gear reduction ratio. The gears are coupled to the shaft of wheel.

Fig4.1 Experimental setup

Fig 4.2 Top View of the setup

4.2 DESIGN AND CALCULATION

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4.1Tabulation

Gear	Speed in rpm	Fertilizer weight in kg	Time in min	Flow rate in kg/s
I Gear	1200	40	90	0.007
II Gear	1200	40	77	0.0086
Low 1 Gear	1200	40	63	0.0105
Low 2 Gear	1200	40	55	0.0121
Low 3 Gear	1200	40	42	0.0158
Low 4 Gear	1200	40	32	0.0208

Suitable chain drive
Assume Power, P =1kw
No of teeth on driving wheel Z_1=18 teeth
No of teeth on driving wheel Z_2=18 teeth
Centre distance = 580mm
Step 1
Transmission ratio $i=Z_2/Z_1$
i=18/18 =1
Step 2
Optimum centre distance
a =30 p to 50 p, where
p is the pitch
p_{max} = 580/30
=19.33mm
p_{min} =580/50
=11.6mm
FROM PSG DB P.NO, 7.72
Pitch behavior is between 11.6mm to 19.33mm
We select 15.875mm
Step 3
Selection of Chain No
From PSG DB P.NO,7.72
Select Chain No: 10A-1(simpeller roller chain)
P =15.875mm
Breaking Area A =0.70cm^2
Weight per meter w=1.01kgf
Breaking Load Q =2220kgf
Step 4
Calculated power transmitted on breaking on breaking load from DB 7.77

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N =Q.V/102*n*Ks = 1KW

V =P*Z1*n1/60*1000

=15.875*18*1200/(60*1000)

=5.715 m/s

n =Min.value factor of safety

From PSG DB 7.77

n =11.7

$K_1=K_2=K_3=K_4=K_5=K_6=1$

Ks=1

N =Q*5.715/(102*11.7*10)

Breaking load Q =208.81 Kgf

it is less than the selected chain breaking load of 2220 Kgf.

Step 5

a) Calculation of length of Chain

b) Final Center distance

Length of continuous Chain in multiples of Pitch

l_p = 92 mm

(a)Length of chain L =lp*P

=92*15.875

=1460mm

(b)Final Centre distance a =e+ $(e_2\text{-}8m)^2$*P /4 [e=lp-(z_1+z_2)/2]

=1248.72/4 =315 mm

Step 6

Check actual Factor of Safety from PSG DB 7.78 Actual Factor of Safety =[n]

=Q/ΣP

Where,Q is the Breaking load of the chain =2220 Kgf

ΣP =Pt + Ps + Pc

Pt =Tangential force due to power transmission

=102*N/V

=102*1/5.71 =17.86 Kgf

Pc =Centrifugal tension = Wv^2/g

= $1.01*5.716^2/9.81$ =3.35 Kgf

Ps =Tension due to Sagging =K*W*a [from DB 7.78 K=Vertical =1]

=1*1.01*0.315 =0.318 Kgf

ΣP =17.86 + 3.35 + 0.318

=21.528 Kgf

Actual factor of safety =[n]=Q/ΣP

=2220/21.528

[n] =103.12>11.7

(Greater than allowable factor of safety)

Step 7:

Checking of allowable bearing stress

From PSG DB 7.77

Allowable bearing stress = 2.10 kgf/mm^2

Power transmitted on the basis of allowable bearing stress=N=σAv/102 Ks

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$1 = \sigma * 0.70 * 5.71 / 102 * 1$
$= 25.51 kgf/cm^2$
$= 0.2551 kgf/mm^2$

which is less than allowable stress of 2.10 kgf/mm^2
The design is satisfactory.

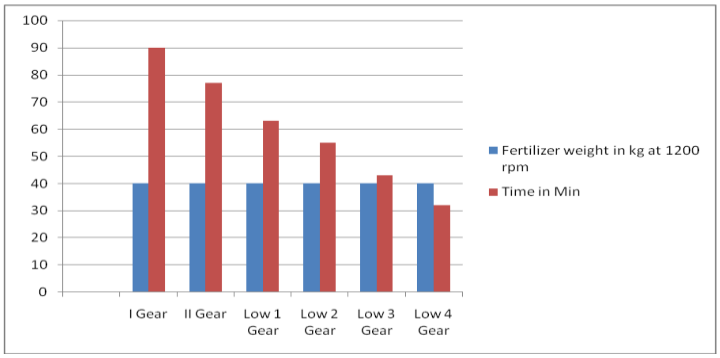

Chart-I Fertlizer weight and Time at various gear speed

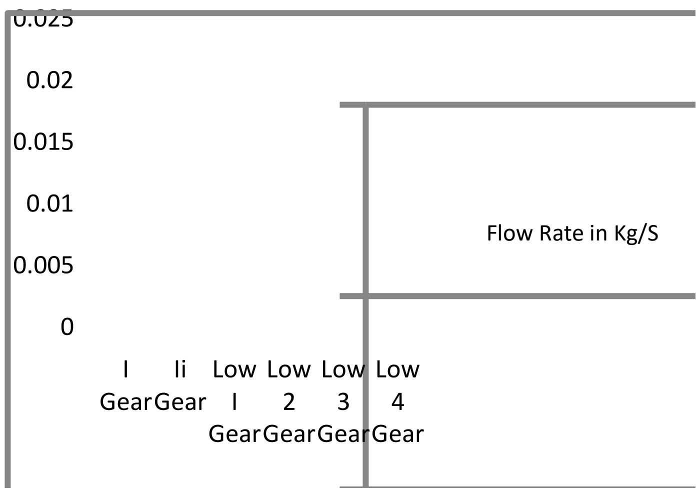

Chart-II Flow rate at various gear speed

V CONCLUSION

From this project, we came to know by using this mechanism the reduction of manual work can be acheived, thus reduces the time and the cost. Thus it will serve more effective work than the conventional methods adopted. This project will be more useful in our country as around 70% of population directly or indirectly involves in agricultural and farming. This project has wide advantages with less expense. Here we are analyses the prototype of the model which can be suitably modified for the future requirements.

ACKNOWLEDGEMENT

The authors are very much thankful to the management of Roever Engineering College, Elambalur, Perambalur – 621 212.

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